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First Named Inventor	HIRONORI OSUGA
Group Art Unit	1712
Examiner Name	Robert E. Sellers
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  Request for Reconsideration; reply postcard

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

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Signature	[signature]
Date	March 17, 2003

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:
HIRONORI OSUGA

Serial No.: **09/807,816**
(National Phase of PCT/JP00/05992)

Filed: **April 19, 2001**

For: EPOXY RESIN COMPOSITION AND SEMICONDUCTOR DEVICE

Art Unit: 1712

Examiner: Robert E. Sellers

REQUEST FOR RECONSIDERATION

Assistant Commissioner for Patents
Washington, D.C. 20231
Sir:

Reconsideration is respectfully requested of the Office Action of December 18, 2002, relating to the above-identified application.

The rejection of Claims 1-7 under 35 U.S.C. § 102(b) or 103(a) in view of *Shiobara* '266 is traversed and reconsideration is respectfully requested.

The rejection of Claims 1, 2, 4 and 6 under 35 U.S.C. § 102(b) or 35 U.S.C. § 103(a) in view of JP 11-71444; JP 11-92631; JP 11-130938; JP 11-100490 or JP 100491 is traversed and reconsideration is respectfully requested.

The rejection of Claims 1-7 under 35 U.S.C. § 102(a) or 35 U.S.C. § 103(a) in view of *Takami* is traversed and reconsideration is respectfully requested.

The rejection of Claims 1-7 under 35 U.S.C. § 102(e) or 35 U.S.C. § 103(a) in view of *Fuiji* is traversed and reconsideration is respectfully requested.

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Susan J. Revell

Susan J. Revell

The rejection of Claims 1, 2, 4 and 6 under 35 U.S.C. § 102(a) or 35 U.S.C. § 103(a) in view of *Shiobara* '774 is traversed and reconsideration is respectfully requested.

The rejection of Claims 1, 2, 4 and 6 under 35 U.S.C. § 102(e) or 35 U.S.C. § 103(a) in view of *Okusa* or *Arai* '978 is traversed and reconsideration is respectfully requested.

The rejection of Claims 1-7 under 35 U.S.C. § 103(a) in view of *Arai* '908 is traversed and reconsideration is respectfully requested.

Applicants have grouped all the rejections and all 12 references together because the basic issue is the same with respect to each rejection and each of the cited references.

Applicants respectfully submit that the references, either individually or collectively or in any combination, fail to anticipate or render obvious the claimed subject matter of this application.

It is acknowledged that epoxy resins, phenolic resins, curing accelerators and inorganic fillers as main components for epoxy resin compositions are well known for many purposes.

What is novel and inventive about the present invention is an epoxy resin composition for encapsulating of semiconductors which comprises (A) an epoxy resin, (B) a phenolic resin, (C) a curing accelerator and (D) an inorganic filler as main components, wherein the cured product formed by heating and curing the epoxy resin composition meets the parameters of $a \geqq 10^R$ ($R=10\times(b+c)-1$), $300 \leqq a \leqq 20000$ and $0.15 \leqq b+c \leqq 0.50$ in which (a) denotes a flexural modulus (N/mm^2) at molding temperature, (b) denotes a cure shrinkage (%) and (c) denotes a heat shrinkage (%) from molding temperature to room temperature.

In particular, the parameters of the present invention in the above three requirements, 1) $a \geqq 10^{R}$ ($R=10\times(b+c)-1$), 2) $300 \leqq a \leqq 20000$ and 3) $0.15 \leqq b+c \leqq 0.50$ have been shown to be critical in achieving the intended results. That is, only when a (flexural modulus at molding temperature), b (cure shrinkage), and c (heat shrinkage from molding temperature to room temperature) meet all three requirements can there be obtained an epoxy resin composition and a semiconductor device which have less warping after molding and soldering in the so-called area mounting type semiconductor device and which have excellent reliability in soldering because of particularly excellent adhesiveness to an organic substrate. These parameters as defined herein achieve the benefits and improvements that have been searched for in the past to overcome the problems discussed in this application; see pages 4 and 5.

Examples 1-6 in Table 1 on page 20 of the present specification and Comparative Examples 1-6 in Table 2 on page 21 of the present specification represent the data of unexpected results that are obtainable as a result of the present invention.

In order to give the Examiner an even greater understanding of the present invention, applicants have added some modifications to Table 1, Table 2 and Fig. 1. The modified Table 1, Table 2 and Fig. 1 are enclosed herewith. In the modified Tables 1 and 2, ○ means that one of the three requirements is satisfied, and × means that one of the three requirements is not satisfied.

As explained in the present specification, there is a clear relationship between the above three requirements and properties such as warping as discussed below.

In order to reduce warping in semiconductor devices, two methods have been considered to be important, namely, the first one which comprises making the thermal expansion coefficient of the substrate and that of the cured product of an epoxy resin composition close to each other and the second which comprises reducing the cure shrinkage of the epoxy resin composition. In other words, for the reduction of warping, it is necessary to reduce the cure shrinkage and the heat shrinkage that takes place from molding temperature down to room temperature in an epoxy resin composition.

However, the reduction of the warping would still be insufficient by carrying out only reduction of the cure shrinkage and the heat shrinkage from molding temperature to room temperature. As a result of the intensive research conducted by applicant, it has been found that the flexural modulus measured at the molding temperature also greatly affects the warping.

That is, it has been found that when the flexural modulus at molding temperature is low, warping is large, and that when the flexural modulus is high, warping is small. It has further been found that all of the parameters; namely, flexural modulus at molding temperature(a), the cure shrinkage(b) and the heat shrinkage from the molding temperature to room temperature(c) affect properties such as warping in combination.

When (a) is not less than 10^R where $R=10\times(b+c)-1$, warping decreases and this is preferred (see, Examples 1-6 in the modified Table 1), and when (a) is less than 10^R, warping increases and this is not preferred (see, Comparative Examples 1-2 in the modified Table 2). That is, when the flexural modulus(a) is higher, warping decreases. On the other hand, when the

cure shrinkage(b) and the heat shrinkage(c) are higher, unless the flexural modulus (a) is sufficiently high to satisfy $a \geqq 10^R$, warping increases.

When (a) is less than 300, the cured product becomes soft at curing and molding to cause deterioration of releasability from the mold, namely moldability (see, Comparative Example 3 in the modified Table 2). When (a) exceeds 20000, fluidity is insufficient and moldability is deteriorated (see, Comparative Example 5 in the modified Table 2). That is, the flexural modulus(a) affects also moldability, and even if (a) satisfies $a \geqq 10^R$, when (a) is too small, releasability deteriorates, and when (a) is too large, fluidity deteriorates.

When b+c is less than 0.15, cure shrinkage at molding and curing is small and releasability from the mold is insufficient to cause deterioration of moldability (see, Comparative Example 4 in the modified Table 2), and when b+c exceeds 0.50, heat shrinkage is large and due to the increase of internal stress, soldering crack resistance is lowered (see, Comparative Example 6 in the modified Table 2). That is, the cure shrinkage(b) and the heat shrinkage(c) affect also moldability and internal stress, and when they are too small, releasability deteriorates, and when they are too large, internal stress increases.

<u>Relation Between The Above Three Requirements And Resin Compositions</u>

As will be clear from Table A, below, a comparison between Examples 1,2,6 and Comparative Examples 5,6 in the present specification and Table B showing comparison between Example 3 and Comparative Example 2 in the present specification, shows that even though the epoxy resins, phenolic resins, curing accelerators and inorganic fillers used in

Examples are respectively identical with those used in Comparative Examples, when all of the above three parameters are not satisfied, good properties such as releasability, flowability, warping of package, and soldering crack resistance cannot be obtained.

Thus, notwithstanding that the cited references may disclose epoxy resins, phenolic resins, curing accelerators, and inorganic fillers similar to those used in the resin composition of the present invention, they do not describe all of the above three parameters and do not lead persons skilled in the art to this information. Hence, persons skilled in the art would not be able to understand the relationship between these parameters and obtaining good results.

Table A

	Ex. 1	Ex. 2	Ex. 6	Comp.Ex. 5	Comp.Ex. 6
Epoxy resin	Formula (1)	Formula (1)	Formula (1)	Formula (1)	Formula (1)
Phenolic resin	Formula (2)	Formula (2)	Formula (2)	Formula (2)	Formula (2)
Filler, silica %	83.25	83.30	87.30	87.15	79.10
Accelerator, TPP %	0.15	0.10	0.10	0.25	0.30
Flexural modulus, a	14000	8000	10000	24000	17000
Shrinkage, (b+c)	0.28	0.42	0.20	0.20	0.52
Releasability	Good	Good	Good	Not filled	Good
Warping, μm of package	50	80	30	Not filled	130
Soldering crack resistance	Good	Good	Good	Not filled	Bad

Table B

	Example 3	Comparative Example 2
Epoxy resin	Formula (3)	Formula (3)
Phenolic resin	Formula (5)	Formula (5)
Filler, silica %	91.25	87.20
Accelerator, TPP %	0.15	0.20
Relation between a and 10^R	$a>10^R$	$a<10^R$
Flexural modulus, a	1500	1000
Shrinkage, (b+c)	0.40	0.45
Releasability	Good	Good
Warping, μm of package	80	120
Soldering crack resistance	Good	Good

Comparison Between The Present Invention And The Cited References

None of the cited twelve references disclose or suggest the three parameters which constitute the feature of the present invention, that is, $a \geqq 10^R$ ($R=10\times(b+c)-1$), $300 \leqq a \leqq 20000$ and $0.15 \leqq b+c \leqq 0.50$ in which a denotes a flexural modulus (N/mm^2) at molding temperature, b denotes a cure shrinkage (%) and c denotes a heat shrinkage (%)from molding temperature to room temperature.

The references disclose epoxy resins, phenolic resins, curing accelerators and inorganic fillers generally similar to those used in the present invention. However, the present invention resides in the combination of epoxy resins, phenolic resins, curing accelerators and inorganic fillers and the above three parameters.

As explained above with regard to Table A and Table B, even though the epoxy resins, phenolic resins, curing accelerators and inorganic fillers used in Examples of the present

application are respectively identical with those used in Comparative Examples of the present application, when all of the above three parameters are not satisfied, good properties such as releasability, flowability, warping of package, and soldering crack resistance cannot be obtained.

And to address the issue of inherency raised in the Office Action, even if the cited references disclose epoxy resins, phenolic resins, curing accelerators, and inorganic fillers similar to those used in the resin composition of the present invention, this does not necessarily mean that all of the above three parameters are satisfied in the references; and, hence, it is not established that all of properties equivalent to those obtained in the present invention can be obtained by following the teachings of the references.

The Official Action expresses the reasons in support of the rejection as being inherent in the prior art reference. The inherent teaching of a prior art reference is a question of fact and can arise in both the context of anticipation and obviousness. *In re Napier,* 55 F.3d 610, 613, 34 USPQ2d 1782, (Fed. Cir. 1995). It is also well established that an allegation that a certain result or characteristic may occur or be present in the prior art is not a sufficient basis to establish the inherency of that particular result or characteristic. See, *In re Rijckaert*, 9 F.3d 1531, 1534, 28 USPQ2d 1955 (Fed. Cir. 1993) which reversed a rejection because inherency was based on what would result due to optimization of conditions and not what was necessarily always present in the prior art. See also, *In re Oelrich*, 666 F.2d 578, 212 USPQ 323 (CCPA 1981). To establish inherency, the extrinsic evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by

persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. See, *In re Robertson*, 169 F.3d 743, 49 USPQ2d 1949 (Fed. Cir. 1999).

In relying upon the theory of inherency, the burden is upon the examiners to provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art. See, *Ex Parte Levy*, 17 USPQ2d 1461 (BPAI 1990).

It is clear from the cases quoted above that the courts have emphasized that in order to sustain a rejection based on inherency, the burden is upon the examiner to establish that the claimed result would necessarily result from the operation of the patented invention.

In other words, irrespectively of the kinds of epoxy resins, phenolic resins, curing accelerators, and inorganic fillers, it is only when all of the above three parameters which constitute the feature of the present invention are satisfied, that good properties such as releasability, flowability, warping of package, and soldering crack resistance can be obtained.

Respectfully submitted,

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Modified Table 1

	Example					
	1	2	3	4	5	6
Epoxy resin of formula (1)	10.2	10.2				7.6
Epoxy resin of formula (3)			4.2	5.9		
Epoxy resin of formula (4)					6.4	
Phenolic resin of formula (2)	5.8	5.8				4.4
Phenolic resin of formula (5)			3.8			
Phenolic resin of formula (6)				6.1	5.6	
Spherical fused silica	83.25	83.30	91.25	87.20	87.30	87.30
Triphenylphosphine	0.15	0.10	0.15	0.20	0.10	0.10
Carbon black	0.3	0.3	0.3	0.3	0.3	0.3
Carnauba wax	0.3	0.3	0.3	0.3	0.3	0.3
Spiral flow (cm)	100	100	80	70	80	70
Curability	95	95	90	95	95	95
Flexural modulus a (N/mm^2)	14000	8000	1500	600	1500	10000
b + c (%)	0.28	0.42	0.40	0.28	0.20	0.20
Moisture absorption rate (wt%)	0.26	0.27	0.10	0.10	0.09	0.22
Releasability	Good	Good	Good	Good	Good	Good
Warping amount of package (μm)	50	80	80	30	20	30
Soldering crack resistance (60℃)	0/10	0/10	0/10	0/10	0/10	0/10
Soldering crack resistance (85℃)	10/10	10/10	0/10	0/10	0/10	8/10
$10^{10\times(b+c)-1}$	63	1585	1000	63	10	10
$a \geqq 10^{10\times(b+c)-1}$	○	○	○	○	○	○
$300 \leqq a \leqq 20000$	○	○	○	○	○	○
$0.15 \leqq b+c \leqq 0.50$	○	○	○	○	○	○

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Modified Table 2

	Comparative Example					
	1	2	3	4	5	6
Epoxy resin of formula (1)				4.9	7.6	12.7
Epoxy resin of formula (3)	10.7	6.3	5.2			
Phenolic resin of formula (2)	5.3				4.4	7.3
Phenolic resin of formula (5)		5.7				
Phenolic novolak resin			2.8	3.1		
Spherical fused silica	83.25	87.20	91.35	91.35	87.15	79.10
Triphenylphosphine	0.15	0.20	0.05	0.05	0.25	0.30
Carbon black	0.3	0.3	0.3	0.3	0.3	0.3
Carnauba wax	0.3	0.3	0.3	0.3	0.3	0.3
Spiral flow (cm)	100	80	70	70	20	140
Curability	95	85	50	85	95	100
Flexural modulus a (N/mm^2)	400	1000	200	1600	24000	17000
b + c (%)	0.38	0.45	0.16	0.13	0.20	0.52
Moisture absorption rate (wt%)	0.16	0.11	0.08	0.15	0.26	0.33
Releasability	Good	Good	Bad	Bad	Unfilled	Good
Warping amount of package (μm)	110	120	40	30	Unfilled	130
Soldering crack resistance (60℃)	0/10	0/10	0/10	0/10	Unfilled	10/10
Soldering crack resistance (85℃)	2/10	0/10	0/10	5/10	Unfilled	10/10
$10^{10\times(b+c)-1}$	631	3162	4	2	10	15849
$a \geqq 10^{10\times(b+c)-1}$	×	×	○	○	○	○
$300 \leqq a \leqq 20000$	○	○	×	○	×	○
$0.15 \leqq b+c \leqq 0.50$	○	○	○	×	○	×